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FORTY-FIRST ANNUAL REPORT

Fiscal Year Ending June 30, 1930

OF THE

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

M. J. FUNCHESS, *Director*

AUBURN, ALABAMA

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TRANSMITTALS

Alabama Polytechnic Institute,
Auburn, Alabama.

President Bradford Knapp,
Auburn, Alabama.

Dear Doctor Knapp:

I have the honor to submit herewith the Forty-first Annual Report of the Agricultural Experiment Station of the Alabama Polytechnic Institute.

Yours very truly,

M. J. Funchess,
Director.

Alabama Polytechnic Institute,
Auburn, Alabama.

Governor Bibb Graves,
Montgomery, Alabama.

Dear Sir:

I take pleasure in transmitting to you the Forty-first Annual Report of the Alabama Experiment Station of the Alabama Polytechnic Institute.

Yours very truly,

Bradford Knapp,
President.

ALABAMA POLYTECHNIC INSTITUTE

COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

TRUSTEES

His Excellency, Bibb Graves, President	Ex Officio
A. F. Harman, Superintendent of Education	Ex Officio
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Oliver R. Hood (Seventh District)	Gadsden
C. W. Ashcraft (Eighth District)	Florence
Victor H. Hanson (Ninth District)	Birmingham
P. S. Haley (Tenth District)	Oakman

EXPERIMENT STATION STAFF

Bradford Knapp, B. S., LL.D., D. Agr., President
M. J. Funchess, M. S., Director of Experiment Station
W. H. Weidenbach, B. S., Secretary
P. O. Davis, B. S., Agricultural Editor
Mary E. Martin, Librarian
Sara Willeford, Agricultural Librarian

Agricultural Economics:

J. D. Pope, M. S.	Agricultural Economist
B. F. Alvord, M. S.	Associate Agricultural Economist
C. G. Garman, B. S.	Assistant Agricultural Economist
E. E. McLean, M. A.	Assistant in Agricultural Economics
Carl F. Clark, M. S.	Assistant in Agricultural Economics
Edith M. Slights	Statistical Assistant

Agricultural Engineering:

M. L. Nichols, M. S.	Agricultural Engineer
J. W. Randolph, M. S.	Assistant Agricultural Engineer
Arvey Carnes, B. S.	Assistant Agricultural Engineer
Ellis Diseker, B. S.	Assistant in Agricultural Engineering
T. N. Jones, B. S.	Assistant in Agricultural Engineering

Agronomy and Soils:

M. J. Funchess, M. S.	Agronomist
J. W. Tidmore, Ph.D.	Soil Chemist
L. D. Baver, Ph.D.	Associate Soil Chemist
H. B. Tisdale, M. S.	Associate Plant Breeder
J. T. Williamson, B. S.	Associate Agronomist
R. Y. Bailey, B. S.	Assistant Agronomist
D. G. Sturkie, M. S.	Assistant Agronomist
G. D. Scarseth, B. S.	Assistant Soil Chemist
*W. W. Pate, M. S.	Assistant Soil Chemist
W. D. Lucas, B. S.	Assistant in Agronomy
E. L. Mayton, B. S.	Assistant in Agronomy
J. W. Richardson, B. S.	Assistant in Agronomy
J. R. Taylor, B. S.	Assistant in Agronomy
H. W. Bennett, B. S.	Assistant in Agronomy
G. H. Jester, B. S.	Assistant in Soils
J. A. Naftel, B. S.	Assistant in Soils
C. J. Rehling, B. S.	Assistant in Soils

Animal Husbandry, Dairying, and Poultry:

J. C. Grimes, M. S.	Animal Husbandman
W. C. Taylor, B. S.	Assistant in Animal Industry
W. D. Salmon, A. M.	Research Professor of Animal Nutrition
N. B. Guerrant, Ph.D.	Research Assoc. Prof. of An. Nutrition
S. J. Schilling, D.V.M.	Research Assoc. Prof. of An. Nutrition
J. E. Ivey, M. S.	Poultry Husbandman
G. A. Trollope, B. S.	Poultry Husbandman
Dale F. King, M. S.	Associate Poultry Husbandman
C. T. Bailey, B. S.	Superintendent, Poultry Farm

Botany and Plant Pathology:

W. A. Gardner, Ph.D.	Botanist
J. L. Seal, Ph.D.	Associate Plant Pathologist
G. L. Fick, M. S.	Assistant Botanist
E. V. Smith, B. S.	Assistant in Botany

Entomology:

J. M. Robinson, M. A.	Entomologist
L. L. English, Ph.D.	Associate Entomologist
H. S. Swingle, M. S.	Associate Entomologist
F. S. Arant, M. S.	Assistant Entomologist

Farm Management:

J. F. Duggar, M. S.	Professor of Farm Management

Home Economics:

Louise P. Glanton, M. A.	Home Economist
A. L. Sommer, Ph.D.	Associate Home Economist

*Assigned by the State Department of Agriculture and Industries.

Horticulture and Forestry:

C. L. Isbell, Ph.D.	Horticulturist
W. D. Kimbrough, Ph.D.	Associate Horticulturist
O. C. Medlock, M. S.	Assistant Horticulturist
R. W. Taylor, M. S.	Assistant Horticulturist
P. L. Wright, B. S.	Assistant in Horticulture

Agricultural Substations:

Fred Stewart, B.S.	Superintendent, Tennessee Valley Substation, Belle Mina, Alabama
R. C. Christopher, B.S.	Superintendent, Sand Mountain Substation, Crossville, Alabama
J. M. Henderson, B.S.	Asst. Superintendent, Sand Mountain Substation, Crossville, Alabama
J. P. Wilson, B.S.	Superintendent, Wiregrass Substation, Headland, Alabama
K. G. Baker, B. S.	Superintendent, Black Belt Substation, Marion Junction, Alabama
Otto Brown, M. S.	Superintendent, Gulf Coast Substation, Fairhope, Alabama

CHANGES IN STATION STAFF DURING 1929-1930

Appointments:

B. F. Alvord, M. S.	Associate Agricultural Economist
Carl F. Clark, M. S.	Assistant in Agricultural Economics
E. E. McLean, M. A.	Assistant in Agricultural Economics
Arvey Carnes, B. S.	Assistant Agricultural Engineer
T. N. Jones, B. S.	Assistant in Agricultural Engineering
L. D. Baver, Ph.D.	Associate Soil Chemist
*W. W. Pate, M. S.	Assistant Soil Chemist
C. J. Rehling, B. S.	Assistant in Agronomy
J. W. Richardson, B. S.	Assistant in Agronomy
J. R. Taylor, B. S.	Assistant in Agronomy
H. W. Bennett, B. S.	Assistant in Agronomy
G. A. Trollope, B. S.	Poultry Husbandman
Dale F. King, M. S.	Associate Poultry Husbandman
C. T. Bailey, B. S.	Superintendent of Poultry Farm
E. V. Smith, B. S.	Assistant in Botany
H. S. Swingle, M. S.	Associate Entomologist
Louise P. Glanton, M. A.	Home Economist
A. L. Sommer, Ph.D.	Associate Home Economist
P. L. Wright, B. S.	Assistant in Horticulture
K. G. Baker, B. S.	Superintendent, Black Belt Substation
J. M. Henderson, B. S.	Asst. Superintendent, Sand Mountain Substation
Otto Brown, M. S.	Superintendent, Gulf Coast Substation

Resignations:

F. W. Parker, Ph.D.	Soil Chemist
L. G. Brackeen, M. S.	Assistant in Agronomy
W. C. Taylor, B. S.	Assistant in Animal Industry
J. E. Ivey, M. S.	Poultry Husbandman
S. J. Schilling, D. V. M.	Research Assoc. Prof. of An. Nutrition
Helen D. Herren, A. M.	Assistant in Home Economics

*Assigned by the State Department of Agriculture and Industries.

NEW PUBLICATIONS

Bailey, R. Y., Williamson, J. T., and Duggar, J. F.—**Experiments with Legumes in Alabama.** *Alabama Experiment Station Bulletin 232.* This bulletin reports the results of studies with legumes concerning: (1) effect on succeeding crops; (2) lime and fertilizer requirements; (3) time, method, and rate of seeding; (4) yields at different stages of growth; (5) nitrogen content; (6) seed production; and (7) the effect of low temperatures.

The results showed that legumes supplied enough nitrogen to produce satisfactory crops of corn and cotton in continuous cropping systems, two-year rotations, and three-year rotations. These studies also showed that legumes respond remarkably to phosphorus and lime. Early planting was found to be essential to successful growth of winter legumes.

Arant, F. S.—**Biology and Control of the Southern Corn Rootworm** (Diabrotica 12-punctata, Fab.). *Alabama Experiment Station Bulletin 230.* This bulletin reports the detailed studies of the life history and ecological associations of this pest. The methods of control were studied with special reference to the damage done by the larvae to the young corn plants following the turning of vetch.

The larvae of a tachinid fly (Celatoria diabroticae) devoured the soft internal body tissues of overwintering adult beetles. The destruction of adult beetles by this parasite was at the peak in mid-winter and gradually decreased until late summer. The beetles killed in this manner varied from 2 to 19 per cent during the years 1927, 1928, and 1929.

CONTRIBULTIONS TO SCIENTIFIC JOURNALS

Tidmore, J. W.—**The Phosphorus Content of the Soil Solulution and Its Relation to Plant Growth.** *Jour. Amer. Soc. Agron., 22, 481-488.* This study deals with the minimum phosphate concentration for maximum plant growth in solution cultures, plant growth in soils whose displaced solutions contain only small amounts of phosphate, and the inadequacy of the phosphate in the displaced soil solutions for plant growth.

Pierre, W. H.—**Neutralizing Values and Rates of Reaction with Acid Soils of Different Grades and Kinds of Liming Materials.** *Soil Sci., 29, 137-158.* This paper reports a study of the effects, after various periods of time, of ground limestone, crushed oyster shell, and basic slag, of different degrees of fineness, on the reaction of soils in greenhouse pots, especially as influenced by the H ion concentration of the soil.

Pierre, W. H., and Bertram, F. E.—**Kudzu Production with Special Reference to Influence of Frequency of Cutting on Yields and Formation of Root Reserves.** *Jour. Amer. Soc. Agron., 21, 1079-1101.* Experiments with kudzu are reported regarding the effect of cutting treatments on yields of hay and on the production of reserve foods in the roots.

Baver, L. D., and Rehling, C. J.—**The Use of Barium Sulfate for Clarifying Soil Suspensions with Particular Reference to Colorimetric pH Determinations.** *Jour. Ind. Eng. Chem., Anal. Ed., 2, 338-341.* Colorimetric pH determinations of soils can quickly and easily be made by clarifying the soil suspensions with "x-ray purity" $BaSO_4$.

Scarseth, G. D., and Stroud, J. F.—**The Black Belt Soils of Alabama.** *American Soil Survey Association, Bul. XI, 174-189.* This study gives a description of the soil series found in the Black Belt soil province and describes the relationship between the different soil series and the geological formation.

Sturkie, D. G.—**The Influence of Various Top-Cutting-Treatments on Rootstocks of Johnson Grass** (Sorghum halepense). *Jour. Am. Soc. Agron. 22, 82-93.* This paper reports the results of a study to determine the time of rootstock development of Johnson grass and the influence that various top-cutting-treatments had on their development. The rootstocks were formed usually after the head appeared and developed rapidly as seed were formed. Late in the summer a few were formed even though plants were not permitted to head.

Yields are reported for both top and rootstocks. All cutting treatments reduced rootstock formation, but the more frequently the cuttings were made the greater was the reduction. Cutting only in late stages or not cutting after the middle of the summer enabled the plants to develop large system of rootstocks. A large rootstock system enabled the plants to make a much larger growth the following year than did a small one.

Kimbrough, W. D.—**The Effect of Fertilizer on the Quality and Keeping Quality of Watermelons.** *Pl. Phys. 3, 373-385, 1930.* A report of four years' study did not show that fertilizer treatment had any effect on the quality or keeping quality of watermelons.

AGRICULTURAL ECONOMICS

Relation of Grade and Staple of Cotton to Prices Paid to Farmers in Alabama. (J. D. Pope and C. M. Clark).—The relation of varieties of cotton to length of staple, yields per acre, and receipts per acre were studied. Twelve hundred and twenty-five farmers in six counties representing the major regions of the state were interviewed. Each of these farmers had produced one or more bales from which samples had been drawn for purposes of this study and on which price data and official grade and staple classification had been obtained. The leading varieties reported by farmers were classified roughly under the four general groups indicated in the accompanying table.

Table 1.—Relation of Variety of Cotton to Staple and Value per Acre

Variety group	Per cent of bales under 7/8″	Yield of lint Pounds per acre	Gross receipts Dollars per acre
Cleveland	4	276	49
Half and Half	36	243	43
Cook	10	162	28
Long Staple	2	155	28

It will be noted that, in general, the gross receipts per acre vary with the yield of lint per acre, irrespective of staple length. For example, 36 per cent of the Half and Half group produced cotton under 7-8 of an inch in length indicating low staple quali-

ty. This group produced a yield per acre of 243 pounds and brought farmers much higher receipts per acre than the group of so-called staple cotton. The latter, in spite of its better quality, brought practically the same price per pound as the Half and Half. These data indicate that, in the areas studied, yield per acre is a more important factor in determining receipts than length of staple.

An Economic Study of Poultry and Cotton Farming in Marshall and DeKalb Counties, Alabama (C. G. Garman).—The farms which had commercial poultry flocks averaged 170 layers per flock for the three years 1927, 1928, and 1929. Production averaged 144 eggs per bird at a cost of 24.5 cents per dozen eggs; the price received for eggs was 30.6 cents per dozen, returning a profit of 6.1 cents per dozen. These farms obtained an average return of $225 per year for the labor spent on the poultry enterprise.

On the farms which had commercial poultry as a sideline to cotton, the labor income from the whole farm business fluctuated less than on the farms which depended almost entirely on cotton for their income. In 1927, when the farmers received almost 20 cents per pound for cotton, those who had only small farm flocks of poultry had higher labor incomes than those who had commercial flocks. In 1929, when the price these farmers received for cotton was four to five cents per pound lower and the price received for eggs was six cents per dozen higher, the farmers with commercial poultry flocks averaged a labor income of $320, whereas the farmers with small farm flocks averaged only $36.

The group of farms having an average yield of lint cotton of less than 300 pounds per acre, averaging 260 pounds, obtained a labor income of $58; the group which had a yield of lint cotton of 400 pounds and over, averaging 457 pounds, obtained a labor income of $529.

The farms having less than 13 acres in cotton, averaging 9 acres, had a labor income of $158; and those with more than 20 acres in cotton, averaging 34 acres, had a labor income of $360.

The farms having less than $50 receipts from miscellaneous sources, such as work off the farm, averaged a labor income of $210; and those having $50 and over from miscellaneous sources averaged a labor income of $380.

The men using two-horse cultivators spent an average of 48 man-hours of labor per acre on cotton before pickling; those not using two-horse cultivators spent an average of 66 man hours. The men using two-horse cultivators averaged a labor income of $329, and those not using cultivators averaged $243.

An Economic Study of the Organization of Farms in the Peanut Area of Alabama with Reference to Hog Production. (J. D. Pope).—The results of the study for the two-year period 1927 and 1928 have indicated that:

(1) As the size of farm increased, the size of the hog enter-

prise did not increase proportionately. In other words, the small farms had greater proportionate number of hogs than the large farms.

(2) As the size of the farm increased, the proportion of crop acreage devoted to peanuts tended to decrease.

(3) As the acreage in peanuts increased, the proportion of peanuts sold for cash instead of being hogged off, increased.

(4) In general, there did not appear to be a great difference between the receipts per acre of peanuts when sold for cash and when sold through hogs.

(5) A positive relationship existed between the yield per acre of cotton and income.

(6) The average cost of producing pork in this area was $6.59 per hundred-weight in 1927 and $7.62 in 1928. There was a profit per hundred-weight of $0.15 in 1927 and a loss of $0.38 in 1928.

(7) In both years of the study the percentage distribution of costs of production of pork was approximately as follows:

	Per cent
Fattening crops, (mostly grazed peanuts)	52
Farm-grown, hand-fed feeds (mostly corn)	30
Purchased feeds	4
Pasture and grazing crops	4
Labor	9
Other feed crops	1
	100

AGRICULTURAL ENGINEERING

Weed Control Studies. (E. G. Diseker).—Tests of various methods of precultivation, such as depth and time of plowing, time of harrowing, and the use of jointer and coulters indicated that these operations had little or no effect on subsequent weediness of the cotton crop.

An adjustable spike-tooth harrow used on sandy soil reduced the weed infestation 75 to 78 per cent without seriously injuring the stand of cotton.

The rotary hoe was a satisfactory implement for the cultivation of young corn and cotton during a dry season on both black belt and sandy soils.

Cotton planted in check rows was successfully grown on badly infested nut grass land with a thinning requirement of 5 hours per acre. The yield of checked cotton was greater than the yield on drilled plots planted under similar conditions.

Experiments With Machinery For Harvesting and Planting Oats. (E. G. Diseker).—Tests showed that the windrow harvester, when used with the pickup attachment on the combine, was better adapted to harvesting oats, under Alabama conditions, than the combine alone. This method allowed the oats

and weeds to become uniformly dry, thus eliminating troubles with wet grain.

Soil Erosion. (T. N. Jones).—Field equipment for studying the factors affecting erosion was constructed on the college farm. This consisted essentially of a series of plots having various grades, arranged so that all material washed from the plots could be caught in concrete cisterns. Apparatus for measuring and controlling the factors which affect erosion was installed and tested.

Solar Heating of Water. (A. Carnes.)—A study of the factors affecting the design of equipment for utilizing solar energy to heat water was concluded and a practical design constructed and tested. This consisted of a glass-covered insulated box containing an absorber made of ¼-inch copper tubing soldered in the valley of galvanized corrugated roofing. The absorber surface was painted black. The water to be heated was circulated through this tubing and stored in an insulated tank. Thirty square feet of exposed absorber furnished sufficient heat to raise the temperature of 30 gallons of water from 68° to 115° F. in an average of three hours on sunny days. A formula for the design of other capacity absorbers follows: $Q = AT/d$; where Q equals British thermal units of heat desired, A equals area of absorber exposed at right angles to sun's rays, T equals number of degrees of temperature through which water is to be heated, and d equals thickness of metal in the absorber surface.

Tractor Lug Studies. (J. W. Randolph).—Laboratory studies of the rolling resistance encountered by tractor wheels on sandy soils were continued. Apparatus especially designed to measure the factors affecting rolling resistance was constructed.

The coefficient of rolling friction for the single wheel in Norfolk sand was found to be extremely high. The rolling resistance of a wheel with lugs varied in reference to lug position. Maximum resistance was obtained when the lug was 2½ to 2¾ inches ahead of center for a 1¼-inch lug, and 3½ to 4½ inches ahead of center for a 2½-inch lug. Lugs tended to prevent the wheel from sinking into the soil, but they increased the rolling resistance.

An empirical formula of Joseph Jaudasek (Automotive Industries, June 19, 1917) gives the rolling resistance of a wheel as equal to the product of 3-8 angle of rim-soil contact in front of axle center times the weight on the wheel. Laboratory results, obtained from a single wheel with a smooth rim, checked closely with results calculated by the above formula. The average rolling resistance of the wheel with lugs in Norfolk sand also checked closely with the results calculated by the Jaudasek formula, but as the lug entered the soil a peak of resistance was developed which was much higher than the calculated resistance. This peak depended upon lug size, lug spacing, and soil hardness. After the lug passed over the bottom wheel-center,

the rolling resistance was found to be less than the calculated resistance.

Soil Dynamics. (M. L. Nichols).—Various soil constants or properties were studied to determine which could best be used as an index to the physical factors affecting tillage. The properties considered were percentage of colloid, heat of wetting, moisture equivalent, capillary pull, freezing point depression, and the Atterberg consistency constants. It was concluded that the Atterberg consistency constants were the most satisfactory indexes to the soil's physical properties. Experiments conducted with a series of soils varying in chemical and physical composition to determine the relationships of these constants to specific soil properties. It was found that a definite relationship existed between friction values, shear, resistance to compression, and these constants. The general reaction of a soil to an implement was also studied by means of pulling chisels through it; it was found that this reaction was a function of the physical properties indicated by the Atterberg constants. The work showed that the reaction due to these properties could be accurately predicted at any moisture content from these constants.

AGRONOMY AND SOILS

A Comparison of Stable Manure, Nitrate of Soda, and Vetch as Sources of Nitrogen for Cotton and Corn. (E. L. Mayton).—An experiment was started in the fall of 1924 to compare the effects of stable manure, nitrate of soda, and vetch on the yields of cotton and corn in a two-year rotation. Manure was applied at the rate of 5 tons per acre each spring; nitrate of soda, at the rate of 325 pounds per acre; vetch was turned about April 1. Monantha vetch was killed by cold in 1928; in 1929 rabbits destroyed vetch and Austrian winter peas on the corn plots. Consequently, only four crops of vetch were turned for cotton and three crops for corn, whereas manure and nitrate of soda were applied to their respective plots each of the five years.

The five-year-average yields in pounds of seed cotton per acre on the three treated plots were as follows: manure, 1,471; nitrate of soda, 1,222; and vetch, 1,231. The five-year-average yields in bushels of corn per acre produced on the different plots were: manure, 38.3; nitrate of soda, 35.7; and vetch, 30.9.

Time of Turning Vetch for Corn and Cotton. (E. L. Mayton). Vetch on different plots was turned for corn about March 25, April 5, and April 15 during the five-year period, 1925-1929. Corn was planted on these plots about April 5, April 20, and May 1, respectively. Adjacent to each vetch plot, two other plots were planted at the same time and fertilized with nitrate of soda. One of the plots planted on each of the dates named received 200 pounds of nitrate of soda per acre. The rates of application for the other plots were as follows: 100 pounds

for the April 5 planting; 300 pounds for the April 20 planting; and 400 pounds for the May 1 planting.

The five-year-average yield of corn following vetch turned early was 22.6 bushels per acre compared with 29.3 bushels on the plot turned April 5, and 29.5 bushels on the plot turned April 15. The increases, due to legumes in the order of turning, were 15.5, 22.2, and 22.4 bushels per acre. Although vetch was killed by cold in 1928, the average yield of corn on each vetch plot was larger than that on either of the adjacent plots that were planted on the same date and fertilized with nitrate of soda.

In a similar experiment, vetch was turned for cotton about March 25, April 5, and April 15, and the cotton planted about April 5, April 15, and April 30, respectively. The plot on which vetch was turned March 25 produced 59 pounds of seed cotton per acre more than the plot turned April 5, and 133 pounds more than the plot turned April 15. These data indicate that early planting of cotton was a more important factor in this experiment than the increase in the growth of vetch on the later-turned plots. In other words, legumes should be turned just as soon as sufficient growth has been made to supply a reasonable amount of nitrogen in order that the planting date of cotton may not be delayed.

Cotton Spacing. (H. B. Tisdale).—In a spacing test conducted on Norfolk sandy loam, cotton was spaced 6, 12, 18, 24, 30 and 36 inches apart respectively in rows 3½ feet apart. There were 1, 2, 3 and 4 plants per hill at each spacing.

The average yields for six years show little difference between cotton spaced 6 inches apart with one plant per hill and that spaced 36 inches apart with 4 plants per hill. There was little difference in yields due to spacings which provided from 12,446 to 33,184 plants per acre.

Effect of Cutting on the Growth of Kudzu. (E. L. Mayton).—Kudzu was cut at different dates in order that the effect of the number of cuttings and the dates of cutting on the yield of hay and on the stand of plants could be determined. Two to five cuttings were made, the date of the last cutting varying from August 15 to October 15.

The average yields for two years show that the plot cut on June 1 and August 15 produced 5,041 pounds of hay per acre as compared with 3,324 pounds on the plot cut May 1, June 1, July 1, August 15, and October 15. The stand was materially reduced on the plots that were cut four or five times per year.

A comparison of Different Rates and Applications of Fertilizer Materials on the Yields of Pasture Plants. (E. L. Mayton).—In the fall of 1925, an area was seeded to bur, white, and ladino clovers and black medic. In the spring of 1926, Dallis grass and lespedeza were seeded on the same area, and in the fall of 1926, Carolina and hop clovers were added. The area was

divided into a number of plots which received different fertilizer treatments. The treatments varied from single salts of nitrogen and phosphorus to different fertilizer mixtures. Phosphorus and potash were to be applied every five or six years with one exception; nitrogenous fertilizers were to be applied as top dressings each year. On one plot all fertilizers were applied as top dressings each year; on three other plots nitrogen was added in several applications. The basic rate of fertilization, designated as NPK, was 200 pounds nitrate of soda, 600 pounds superphosphate, and 150 pounds muriate of potash. The fertilizer treatments were in duplicate on unlimed land and also on land limed at the rate of two tons per acre.

Beginning in 1927, these plots were harvested irregularly with a lawn mower, the growth of the plants being the factor determining the time of harvesting. The three-year-average yields show that limed plots fertilized with 3NPK gave the largest yield—3,127 pounds of dry material per acre. The nitrate of soda on these plots was applied in three applications. The second highest yielding limed plot was fertilized with 2N2P2K, and it produced 2,921 pounds of dry material. On unlimed land the plot fertilized with 2N2P2K produced 2,531 pounds of dry matter per acre as compared with 2,251 pounds on the plot that received 3NPK.

A complete fertilizer in all cases produced higher yields on both limed and unlimed plots than incomplete fertilizers. Plants showed more response to nitrogen than to any other single element. Nitrogen increased the percentage of Dallis grass; phosphorus and potash increased the percentage of both Dallis grass and legumes. Of the plants originally seeded, hop clover in early spring and Dallis grass and lespedeza in summer have furnished the bulk of the harvested material. No other plants were observed on these plots in 1929.

Experiment Fields. (J. T. Williamson).—Three of the Experiment Fields authorized by the Legislature of 1927 were established in time to begin work in 1929. These fields are located near Cahaba, Prattville, and Alexandria. The Cahaba field is given over entirely to work on pecan disease control, while the other two fields are devoted chiefly to work in agronomy and soils.

By September 25, 1929, the last of the ten fields authorized by the Legislature had been established. Each of the ten fields is given a name which is usually the name of the nearest town or prominent community. Below is given the location of the fields with the soil series represented by each field.

Field No.	1	Cahaba	Cahaba soil
	2	Prattville	Greenville soil
	3	Alexandria	Decatur soil
	4	Hackleburg	Ruston soil
	5	Aliceville	Kalmia soil
	6	Monroeville	Orangeburg soil

7	Tuskegee	Susquehanna soil
8	Gastonburg	Lufkin soil
9	Brewton	Norfolk soil
10	LaFayette	Cecil soil

Fertilizer-Rotation Experiments. (J. T. Williamson).—Rotation experiments were started in 1916 near Albertville, Atmore, and Jackson. The Albertville area was located on Hartsell (DeKalb) fine sandy loam soil, the Atmore area on a dark Greenville sandy loam, and the Jackson area on typical Greenville sandy loam. The rotation used was cotton, oats, cowpeas, crimson clover, corn, and crimson clover. After 1924 either hairy vetch or Austrian winter peas were used as the winter legume. In 1924 the amount of superphosphate was reduced from 240 to 200 pounds per acre; prior to this time cottonseed meal and kainit were used for cotton. All minerals for corn were applied at corn planting time from 1916-1920, inclusive; beginning with the fall of 1920, all minerals for corn were applied to the winter legume which preceded corn. Ground limestone was applied at the beginning of each experiment in 1916. The data from the Albertville area for the first four years and from the Atmore area for the first five years were destroyed by fire. The Albertville experiment was discontinued in 1927, the Atmore experiment in 1924, and the Jackson experiment in 1929.

At Albertville (Table 2) the average increase, due to a complete fertilizer containing superphosphate as the source of phosphoric acid, was 503 pounds of seed cotton and 11.7 bushels of corn per acre. Basic slag was more effective than superphosphate by 19 pounds of seed cotton and 3.7 bushels of corn per acre, when used without lime; however, when lime was used, superphosphate produced 32 pounds of seed cotton and 2.7 bushels of corn per acre more than basic slag. When rock phosphate was used without lime at double the rate of superphosphate, it was much less effective on cotton but more effective on corn. When the results with basic slag and superphosphate were compared by years, it was found that basic slag produced the greater yield of cotton in four out of seven years and the greater yield of corn seven out of eight years.

Lime applied in 1916 resulted in an average yearly increase from 1920-1927, inclusive, of 70 pounds of seed cotton and 5.9 bushels of corn when used with a complete fertilizer containing superphosphate. Only the last four years' results are available for the Atmore rotation (Table 2). The average of these results shows that the complete fertilizer, Plot 6, increased the yield of seed cotton 376 pounds and the yield of corn 6.3 bushels per acre. Basic slag and superphosphate were practically equal in value as sources of phosphorus when used without lime. However, when lime was used, superphosphate increased the yield of cotton 104 pounds of seed cotton per acre more than did basic slag. Rock phosphate, when used at double the rate of basic slag or superphosphate, proved to be a satisfactory source of phos-

phorus on both limed and unlimed plots. Liming this soil increased the average yield of cotton 124 pounds per acre; however, the yield of corn was not materially affected by the use of lime.

The average results on the Jackson area are given in Table 3. On unlimed land the average increase due to a complete fertilizer containing superphosphate was 194 pounds of seed cotton per acre for the first seven-year period and 406 pounds for the second seven years. This compares with increases of 212 pounds for the first period and 371 pounds for the second period by a complete fertilizer carrying basic slag as the source of phosphorus. Over the entire fourteen years, the average increase, due to superphosphate, was only 8 pounds of seed cotton per acre greater than the increase due to basic slag. When used on limed land, superphosphate was more effective than basic slag during both periods, although it was only slightly more effective during the first seven years.

While the results show that the cotton yields were greater during the second seven years than during the first, they also show that the yields of corn were less during the last seven than during the first seven years. On the average, the second seven-year period shows an approximate decrease of 3.0 bushels per acre. The increase, due to 350 pounds of a complete fertilizer, was approximately 5 bushels of corn per acre. The use of different sources of phosphorus did not materially affect the yield of corn, although the results during the second period showed a need for phosphorus in some form.

Liming the land was not profitable for corn; this is in sharp contrast to the results obtained with cotton. The 4000-pound application of ground limestone in 1916 produced an average annual increase of 139 pounds of seed cotton or a total increase of 1,946 pounds per acre. The average yearly increase was 162 pounds during the first seven years and 116 pounds during the second seven years.

In these rotation experiments the following points are emphasized:

(1) The importance of a complete fertilizer for cotton;
(2) The value of lime in a rotation carrying winter legumes for soil improvement;
(3) The long-time effect of ground limestone used in a rotation;
(4) The value of basic slag in comparison with superphosphate when both are used without lime;
(5) The slight superiority of superphosphate over basic slag for cotton on limed land;
(6) The small increase due to commercial fertilizers on Greenville soils.

Table 2.—Fertilizer Treatments and Average Yields of Cotton and Corn on Fertilizer Rotation Experiments Conducted near Albertville and Atmore.

Plot No.	Fertilizer*		Albertville 1920-1927		Atmore 1921-1924	
	Pounds per acre	Kind	Seed cotton Ave. 7 crops Lbs. per acre	Corn Ave. 8 crops Bus. per acre	Seed cotton Ave. 4 crops Lbs. per acre	Corn Ave. 4 crops Bus. per acre
1	——	None	128	11.9	208	18.7
2	100 200	Nitrate of soda Superphosphate	459	23.4	462	22.6
3	100 50	Nitrate of soda Muriate of potash	339	20.7	324	19.8
4	200 50	Superphosphate Muriate of potash	359	19.7	504	22.5
5	——	None	139	12.6	240	17.7
6	100 200 50	Nitrate of soda Superphosphate Muriate of potash	634	25.7	654	25.9
7	100 200 50	Nitrate of soda Basic slag Muriate of potash	653	29.4	662	27.2
8	100 400 50	Nitrate of soda Rock phosphate Muriate of potash	482	28.3	630	26.4
9	——	None	126	17.6	330	21.6
10	100 200 50 4000	Nitrate of soda Superphosphate Muriate of potash Limestone (applied 1916)	704	31.6	778	26.5
11	100 200 50 4000	Nitrate of soda Basic slag Muriate of potash Limestone (applied 1916)	672	28.9	674	25.0
12	100 400 50	Nitrate of soda Rock phosphate Muriate of potash	663**	32.5**	748	26.9
13	——	None	267**	21.8**	332	20.2
Ave. no fertilizer plots			131	14.0	278	19.6

*Cottonseed meal used instead of nitrate of soda on cotton, and kainit used instead of muriate of potash on both corn and cotton prior to 1924. Also 240 pounds of superphosphate per acre used prior to 1924.

**Plots 12 and 13 on slightly better land than remainder of experiment, consequently, they are not considered in the discussion of this table.

Table 3.—Fertilizer Treatments and Average Yields of Cotton and Corn on Fertilizer Rotation Experiment Conducted near Jackson, 1916-1929 Inclusive.

Plot No.	Fertilizer*		Seed Cotton (Lbs. per acre)			Corn (Bus. per acre)		
	Pounds per acre	Kind	Ave. first 7 years	Ave. second 7 years	14-year average	Ave. first 7 years	Ave. second 7 years	14-year average
1	——	None	445	414	429	19.7	15.8	17.7
2	100 200	Nitrate of soda Superphosphate	529	635	582	22.5	20.2	21.3
3	100 50	Nitrate of soda Muriate of potash	524	471	498	22.4	16.0	19.2
4	200 50	Superphosphate Muriate of potash	582	720	651	21.0	20.9	20.9
5	——	None	404	438	421	17.6	16.9	17.2
6	100 200 50	Nitrate of soda Superphosphate Muriate of potash	619	854	736	23.8	20.8	22.3
7	100 200 50	Nitrate of soda Basic slag Muriate of potash	637	819	728	24.0	21.5	22.7
8	100 400 50	Nitrate of soda Rock phosphate Muriate of potash	598	821	709	23.1	21.3	22.2
9	——	None	434	479	457	19.3	16.0	17.6
10	100 200 50 4000	Nitrate of soda Superphosphate Muriate of potash Limestone (applied 1916)	781	970	875	25.4	22.8	24.1
11	100 200 50 4000	Nitrate of soda Basic slag Muriate of potash Limestone (applied 1916)	771	902	837	24.6	21.2	22.9
12	100 400 50 4000	Nitrate of soda Rock phosphate Muriate of potash Limestone (applied 1916)	679	794	737	24.0	19.3	21.6
13	——	None	418	461	439	18.4	14.5	16.5
Ave. No. fertilizer plots			425	448	436	18.7	15.8	17.3

*Cottonseed meal used instead of nitrate of soda on cotton, and kainit used instead of muriate of potash on both corn and cotton prior to 1924. Also 240 pounds of superphosphate per acre used prior to 1924.

Cotton Variety Tests. (H. B. Tisdale).—Thirty-three non-wilt-resistant varieties and strains of cotton were tested in Talladega, Calhoun, Cherokee, DeKalb, Limestone, Lee, Autauga, and Pickens counties in 1929. The results are shown in Table 4.

Table 4.—Length of Staple and Yield of Five Highest Yielding Varieties of Cotton in North and Central Alabama.

North Alabama Average 14 tests 1926-1929			Central Alabama Average 9 tests 1926-1929		
Variety	Yield lint in pounds per acre	Length of staple in 1/32 ins.	Variety	Yield lint in pounds per acre	Length of staple in 1/32 ins.
D. P. L. 4-8	371	31.3	D. P. L. 4-8	467	31.8
Cook 1010	370	27.1	Dixie-Triumph	441	28.6
Delfos	367	34.2	Cook 1627	439	29.1
Trice	367	32.0	Cook 588	436	28.2
Cook 1627	360	29.5	Cleveland (Pied)	428	28.4

Eighteen wilt-resistant varieties of cotton were tested in Lee, Autaugua, Lowndes, Covington, Henry, Geneva, and Escambia counties in 1929. The results are shown in Table 5.

Table 5.—Length of Staple and Yield of Five Highest Yielding Wilt-Resistant Varieties of Cotton.

Variety	Yield lint in pounds per acre	Length of staple in 1/32 inches
Cook 307 (Rhyne)	399	28.0
Dixie-Triumph	399	28.4
Toole (Council)	395	28.4
Lewis 63	375	28.4
Cook 307 (Bridges)	371	27.6

Table 6.—Average Yield of Corn per Acre for Three Sections of the State, 1926-1929.

North Alabama Average 9 tests		Central Alabama Average 4 tests		South Alabama Average 3 tests	
Variety	Yield bushels	Variety	Yield bushels	Variety	Yield bushels
Douthit	26.6	Whatley (Hudson)	32.0	Whatley (Whatley Bros.)	25.1
Hastings	26.2	Douthit	30.7	Douthit	22.7
Local Variety	26.0	Whatley (Whatley Bros.)	30.6	Mosby (Delta)	21.2
Neal's Paymaster	25.9	Local Variety	29.4	Local Variety	20.7
Whatley (Whatley Bros.)	25.3	Hastings	28.0	Hastings	19.3

Corn Variety Test (H. B. Tisdale).—Twenty-one varieties of corn were tested in North, Central, and South Alabama in 1929. Table 6 shows the five highest yielding varieties with the yield in bushels of grain per acre for three sections of the state.

Cotton Breeding. (H. B. Tisdale).—The leading varieties of cotton for Alabama are being improved in yield, staple length, and resistance to disease by selection and hybridization.

Winter Legume Breeding. (H. B. Tisdale).—Several promising new strains of Austrian winter peas are being tested for seed production and resistance to disease.

A Study of Some of the Factors Affecting Lint Development in Cotton (D. G. Sturkie).—During the past two years a study of the influence of temperature, evaporation, humidity, soil moisture, and soil type on lint development in cotton has been made. Length of lint and size of boll were not affected by soil or climatic conditions, but were affected by soil moisture. Cotton grown in soil from the Mississippi Delta and that grown in Norfolk sand under optimum moisture conditions produced bolls of the same size and lint of the same length.

The soil moisture at or near the time of blooming had a marked effect on the size of the boll, abundant moisture being associated with large bolls. The amount of soil moisture present from one to fifteen days after a bloom appeared affected the length of lint produced by that boll. Short lint was associated with a low moisture content at that time.

The Influence of Nitrate of Soda on the Yield and Composition of Sudan Grass Hay. (D. G. Sturkie).—The yield and protein content of Sudan grass hay were increased by applying nitrate of soda to young grass. The sodium nitrate treatments used follow: 0, 100, 200, 400, and 600 pounds per acre; in some cases the entire amount was added in one application; in others it was divided into two applications. The most profitable application was 100-200 pounds per acre applied as soon as the grass was up.

The Time of Cutting Sudan and Johnson Grass for Hay. (D. G. Sturkie).—In a study of the time of cutting Sudan and Johnson grass for hay, three cutting treatments were compared; viz., cutting in booting, blooming, and late milk stages. The largest yield was produced when they were cut in the blooming stage; the largest amount of total nutrients was also present at this stage. There were no significant differences in the composition of the two grasses, but Sudan produced a larger yield than did Johnson grass.

Plant Introduction Studies. (D. G. Sturkie).—Several species of Crotalaria made excellent growth and seed yields. Some of these may be of value for soil improvement in this state.

Several close relatives of Bermuda, Bahia, and Centipede

grasses grew well and showed promise as pasture plants. Woolly-Finger grass from South Africa survived an adverse winter and summer and may be a valuable addition to the forage plants for this section. Napier grass has made a large growth on poor sandy soil in a dry summer and has survived a cold winter.

The six-week cowpea made a good seed crop and was very early. The Arlington Velvet Bean was earlier than the other varieties grown in this state and yielded well.

The Nature of Soil Acidity as Affected by the SiO_2-Sesquioxide Ratio. (L. D. Baver and G. D. Scarseth).—Colloids from 27 different soils (southern and northern) were electrodialyzed until free from exchangeable bases. The resulting acid colloidal clays were titrated with N/10 NaOH with the aid of the hydrogen electrode. The total exchange capacity of the colloid and the nature of the soil acid were obtained from the titration curves. These results were compared with the SiO_2-sesquioxide ratio of the soil colloids.

It was found that the nature of the soil acids varied considerably in different soils. In weathered soils their nature appeared to be solely a function of the kind and extent of weathering and independent of the parent material. This indicated that there is more than one type of soil acid. It was suggested that the nature of the soil acids may serve as a criterion in soil classification.

Colloidal material with a high SiO_2-sesquioxide ratio extracted from soils that were well weathered tended to be more highly buffered and exhibited stronger acidity than those colloids having a low ratio. Their total exchange capacity was higher. The buffer capacity of these colloids appeared to be primarily a function of the nature of the soil acid.

There was no one direct relationship between the SiO_2-sesquioxide ratio and the total exchange capacity of the colloid, or the nature of the soil acid. The data suggested that there were several different types of exchange complexes or that free oxides of Al, Fe, and Si were present.

The Nature of the Buffer Capacity of Soils. (L. D. Baver).—The buffering properties of soils were determined by titrating the acid electrodialyzed soils (or their extracted colloids) with N/10 NaOH with the aid of the hydrogen electrode. The organic matter in several soils and their extracted colloids was oxidized with H_2O_2. Free Al_2O_3, Fe_2O_3 and SiO_2 were removed by alternate extraction with N/10 HCl and 2 per cent Na_2CO_3.

The buffering properties of the soil were found to be solely dependent upon the amount and nature of the collodial acids present, and primarily a function of the mineral collodial acids. Organic colloidal material appeared to buffer soils only in the neutral and slightly alkaline regions.

Extraction of soluble Al_2O_3, Fe_2O_3, and SiO_2 did not materially affect the buffering properties.

Applications of phosphate equivalent to ten tons of 16 per cent superphosphate per acre did not impart buffering qualities to the soil.

Treatment of soils with strong mineral acids in order to increase their acidity was found to materially alter the physicochemical properties of soils. Electrodialysis caused no significant change in these properties; it provides an excellent method, therefore, for studying the buffering properties of soils and their extracted colloids.

The Nature of the Inner Layer of Colloidal Clays. (L. D. Baver).—Several investigators have maintained that the OH ion constitutes the inner layer of colloidal clay and that base exchange reactions are associated with the solubilities of the hydroxides of the cations attached to this OH ion. Since the solubility of $Ca(OH)_2$ decreases and that of $Ba(OH)_2$ increases with temperature, a study was made of the amount of these respective cations replaced from colloidal clay by normal KCl at various temperatures. Electrodialyzed Cecil and Putnam colloids saturated with Ba and Ca ions were used.

The data showed that replacement of the Ba or Ca ions was not influenced except at temperatures above 80°C; above this temperature replacement of Ca by KCl increased. This strongly indicates that the replacement of divalent cations from the soil exchange complex is not dependent upon the OH ion as part of the inner layer.

Factors Affecting the Atterberg Consistency Constants. (L. D. Baver).—A study of the relation of the Atterberg consistency constants to soil dynamics has revealed the necessity of evaluating the different factors that affect these constants. Results of this study in addition to data by other investigators have shown that the factors influencing the Atterberg constants are: (1) the size and shape of particles; (2) the clay and colloid content of the soil; (3) the chemical composition of the colloid; (4) the nature of the exchangeable cations on the exchange complex; and (5) organic matter.

Soils with a high content of clay have been observed to possess considerable plasticity. This has been attributed to the properties of the disc-shaped colloidal particles in the soil.

A new theory of soil plasticity has been advanced on the basis of an orientation of these disc-shaped particles. The platelike colloidal particles are assumed to be oriented in such a way that their flat surfaces are in contact, resulting in an increase in the amount of contact between the particles. Between certain moisture contents, corresponding to the range of plasticity of a soil, the surface tension of the water films between the oriented disc-shaped colloidal particles imparts to the soil its cohesive

properties, enabling it to be permanently molded into any desired shape or form.

The plasticity range on the moisture scale is greatly affected by the SiO_2-sesquioxide ratio of the extracted colloid, the nature of the exchangeable cations, and the presence of organic matter. The plasticity number is not materially influenced by these factors. The plasticity range of soils with a small SiO_2-sesquioxide ratio is low on the moisture scale as compared with soils having a large ratio. The plasticity range of soils is generally lowered when K and Na ions are substituted for Ca and Mg on the exchange complex. Organic matter always causes a marked raising of the plasticity range. This effect clearly shows the value of incorporating organic matter in soils in order to improve their physical properties.

The Black Belt Soils of Alabama. (G. D. Scarseth).—The Selma chalk of the upper Cretaceous period is the parent material for the Houston and Sumter soil series. Where erosion has permitted the products of chalk and plant decomposition to remain as a residue, the Houston clay has developed. Where erosion has kept pace with the decomposition of the chalk, the Sumter clay has formed.

The Oktibbeha, Eutaw, and Lufkin soil series are derived from the same parent material. This material was a marine deposit of acid clays, which was deposited on the Selma chalk. The chief difference between these soils is the degree of weathering, which is a result of differences in drainage and aeration of the subsoils. Where the parent clay material is deep, fifteen feet or more to the underlying chalk, the Lufkin clay has developed. Where the parent clay is only two to five feet deep, the Oktibbeha clay has developed. The Eutaw clay has developed between these limits.

The SiO_2-Sesquioxides of Some Black Belt Soils. (G. D. Scarseth).—A chemical study of some profile samples of Black Belt soils showed variations in the degree of weathering in the different soil series as indicated by the SiO_2-sesquioxide ratio of the colloids.

An Oktibbeha clay had a SiO_2-sesquioxide ratio of 1.83 in the surface two-inch layer; this ratio increased to 1.92 at the depth of 18 inches. A Eutaw clay had a ratio of 2.18 in the surface four-inches, which increased to 2.31 at a depth 14 inches. A lufkin clay had a ratio of 3.84 in the surface four-inches, and 3.81 at a depth of 15 inches. The differences in the SiO_2-sesquioxide ratios in these three soils are entirely dependent on the extent of weathering; the Oktibbeha series is the most highly weathered and the Lufkin series the least. A Houston clay had a ratio of 1.90 in the surface six-inches; a Sumter clay had a ratio of 2.37 in the surface four-inches.

A Comparative Study of Soil Types. (W. W. Pate).—Chemical and greenhouse studies of 14 Norfolk fine sandy loams and

other types having similar profiles and found in various parts of the Coastal Plain area were made.

The results of this study showed that the soils and subsoils from Northwest Alabama have a higher replaceable base content than the true Norfolk fine sandy loams or fine sands from South Alabama. This may be due to the higher percentage of silt in the former as a result of weathering from sandstones and shales. The clay content of the soils from the two localities was almost identical.

Exchangeable H was higher in the true Norfolk surface soils; in the subsoils, however, H was higher in the Northwest Alabama samples. The same order existed for the total exchange capacity.

Analyses of the colloids showed that SiO_2 was somewhat higher in the soils and subsoils from Northwest Alabama, while the Al_2O_3 content was considerably lower than in the true Norfolks; the Fe_2O_3 content of the colloids was practically the same. The SiO_2-sesquioxide ratio, therefore, for the South Alabama soils was lower than for the North Alabama soils. This agrees with the generally accepted theories concerning the effect of climate on profile development.

Plant growth on the soils from Northwest Alabama was approximately 35 per cent higher than on the true Norfolk fine sandy loams from South Alabama. The fine sands produced better crops than the fine sandy loams when a complete fertilizer was applied. Plants showed a greater response to lime on the true Norfolk fine sandy loams than on other soils studied.

Phosphate Studies in Solution Cultures. (J. W. Tidmore).—It has previously been shown in this laboratory that corn made approximately twenty-five times as much growth in solution cultures with a phosphate concentration of 0.10 as with 0.05 p.p.m. There was little difference in the phosphate concentration of the sap from these plants.

Studies were made as to the influence of 0.50 and 0.05 p.p.m. PO_4 in the culture solution on the PO_4 content of the sap from the meristematic tissue and PO_4, phospholipin, nitrogen, and sugar content of the plant sap.

Many corn plants were grown in solution cultures having phosphate concentrations of 0.50 or 0.05 p.p.m. Ten plants were harvested weekly for five weeks from each of the treatments for the studies mentioned above.

The results showed that the sap from the stems of plants grown at 0.50 p.p.m. PO_4 had a PO_4 concentration 20 per cent higher than the sap from those grown at 0.05 p.p.m. The higher phosphate concentration in the culture solution increased the PO_4 content of the sap from the meristematic tissue 85 per cent. Sap from the entire root system had a PO_4 concentration of 375 and 270 p.p.m. when the plants were grown at 0.50 and 0.05 p.p.m. PO_4, respectively. This represents an increase of 40 per

cent. There was, however, 97 per cent increase in $P0_4$ concentration in the sap from the meristematic tissue of the roots when the plants were grown at the higher $P0_4$ concentration.

The phosphate concentration of the solution culture did not influence the phospholipin content of the corn plants under the conditions of this experiment.

In every case plants grown at the higher phosphate concentration contained a higher percentage of total nitrogen than those grown at the lower concentration. The sap from the plants grown at 0.05 p.p.m. $P0_4$ contained twice as much NH_4 as that from plants grown at 0.50 p.p.m. This indicates that at the higher $P0_4$ concentration amino acids are formed more rapidly than at the lower concentration.

The sap from the roots and tops of corn plants grown at 0.50 p.p.m. had a higher reducing sugar content than sap from plants grown at 0.05 p.p.m. This may indicate that a higher phosphate concentration facilitates the formation of sugars in the photosynthetic process, or that it aids the enzyme activity in breaking down starch to sugars.

The Phosphorus Content of the Soil Solution and Its Relation to Plant Growth. (J. W. Tidmore).—This study shows that corn will not make a satisfactory growth in culture solutions with a phosphate concentration less than 0.1 p.p.m. $P0_4$; a satisfactory growth can be obtained, however, in many soils whose displaced solution contained less than 0.05 p.p.m. $P0_4$. This indicates that plants growing in these soils obtain phosphate which is not in the displaced solution. The following points should be emphasized in this connection: soil-root contact; solvent action of $C0_2$; extent of root system; plant differences; and a higher $P0_4$ concentration around the soil particle.

The Absorption of Ammonium- and Nitrate-Nitrogen by Plants. (J. A. Naftel).—The amounts of NH_4- and $N0_3$-N absorbed from solution cultures by wheat, cotton and corn at different ages were determined. The absorption of NH_4-N was more rapid than that of $N0_3$-N in the early stages of growth. NH_4-N absorption increased as the acidity of the culture solution decreased; the absorption of $N0_3$-N was only slightly affected by the reaction of the solution used. Total nitrogen absorption was greatest when both forms of nitrogen were present.

Early growth and fruiting of the plants were largest with both forms of nitrogen in the culture solution.

ANIMAL HUSBANDRY, DAIRYING AND POULTRY

Feed Cost of Raising Pigs to Weaning Age. (J. C. Grimes and W. E. Sewell).—Records are being taken on the swine herd to determine: (1) the feed cost of raising pigs to weaning age; (2) the effect of the number of pigs raised per litter on the feed cost of the pig at weaning age; (3) the relation between the

number of pigs in the litter and the size of the pig at weaning age; (4) the relation between the prolificacy of a sow and her value as a mother.

Records have been taken during the past four years and involve 93 litters of 700 pigs. These records show: (1) that the average feed cost of raising a pig to weaning age was $3.69; (2) that the feed cost of raising a pig to weaning age was inversely proportional to the number of pigs raised per litter; (3) that pigs from small litters were larger at weaning age than pigs from large litters; (4) that the more prolific sows were better mothers and raised a greater percentage of their pigs.

Soybean Hay as a Supplement to White Corn and Tankage for Growing and Fattening Hogs. (J. C. Grimes and W. E. Sewell).—Two trials were conducted to determine the value of soybean hay as a supplement to white corn and tankage for growing and fattening hogs in the dry lot. Each trial included three groups of pigs which were fed as follows: Group 1, white corn 9, tankage 1, self-fed; Group 2, yellow corn 9, tankage 1, self-fed; Group 3, white corn 9, tankage 1, self-fed, soybean hay self-fed in rack. Each group received a mineral mixture of charcoal, lime and salt, equal parts by weight.

A summary of the two trials shows that Group 3, which received soybean hay in addition to white corn and tankage, excelled Group 1, which received only white corn and tankage, in both rate and economy of gains; but Group 2, which received yellow corn and tankage, made cheaper and faster gains than either of the other two. The average daily gain in Group 1 was 1.29 pounds; Group 2, 1.48 pounds, and Group 3, 1.41 pounds. The concentrates required for 100 pounds gain was: Group 1, 386.97 pounds; Group 2, 367.56 pounds; Group 3, 379.00 pounds.

Winter Feeding and Time of Marketing Steers. (J. C. Grimes).—Fifty head of long-yearling steers were divided into two groups and wintered as follows: Group 1, Johnson grass hay self-fed; Group 2, Johnson grass hay self-fed and 1.75 pounds cottonseed meal daily. At the end of a 112-day wintering period, the steers were regrouped into lots A and B and placed on pasture. Lot A was on pasture plus 4 pounds of cottonseed meal daily per head, and Lot B was on pasture only.

Results of this experiment show that both groups of steers lost weight during the winter months. Group 1 lost 87 pounds per head and Group 2 lost 1.2 pounds per head. During the grazing period both lots made good gains. Lot A gained 2.46 pounds daily and returned a profit above feed cost of $6.50 per head. Lot B gained 1.62 pounds daily and returned a profit above feed cost of $0.44 per head.

Wintering Stocker Calves and Heifers. (J. C. Grimes).—Records were secured on the feed cost of wintering 138 head of beef calves and 60 head of yearling heifers. The calves were

fed mixed alfalfa and Johnson grass hay, corn-cob-shuck meal, and cottonseed meal; the heifers, Johnson grass hay and cottonseed meal. All animals were on a permanent pasture.

The calves consumed one pound of concentrates and 6.27 pounds of hay daily; they gained 13.6 pounds per head during the winter at a feed cost of $6.47 per head. The yearling heifers received .79 pounds of cottonseed meal and 3.13 pounds of hay per head daily; they lost 12.3 pounds per head in weight during the winter; the feed cost was $2.00 per head.

Feeding Grain to Lambs for the Spring Market. (J. C. Grimes).—In an experiment to determine the economy of feeding grain to lambs that were being finished for the spring market, 166 lambs were divided into two lots and fed as follows: Lot I, consisting of 86 lambs, received a grain mixture composed of 67 per cent ground corn, 21 per cent cottonseed meal, 11 per cent wheat bran, and 1 per cent salt. Lot II, consisting of 80 lambs, received no grain.

The returns per lamb above feed cost and marketing was $6.56 in Lot I and $6.26 in Lot II.

Mineral Supplements in the Dairy Ration. (W. H. Eaton).—The effect of mineral supplements on milk production of cows and size of offspring is being studied. All cows in the college herd are divided into three groups and fed as nearly alike as possible with the exception that Group 1 receives no minerals, Group 2 receives 4 ounces of bone meal daily, and Group 3 receives 4 ounces of marble dust daily. Records are kept on the amount of milk produced by each individual cow and weights and measurements are taken on the offspring.

Records taken on 22 cows and 33 calves during 1929 show that minerals had no marked effect on milk production or size of offspring.

The Stability of Vitamin G as Measured by Its Growth-Stimulating Effect. (N. B. Guerrant and W. D. Salmon).—The purpose of this investigation was to determine the effect of heat, H ion concentration, oxidation, reduction, deamination, and ultra-violet irradiation upon the growth-promoting activity of vitamin G in yeast or yeast extracts.

Heating baker's yeast in an oven for four hours at 120 degrees C, or autoclaving the same yeast for four hours at 20 pounds pressure decreased the vitamin G content 20 to 25 per cent. The H ion concentration determined largely the amount of destruction caused by autoclaving yeast extracts. At pH 10.1 about 90 per cent of the growth-promoting activity was destroyed by autoclaving for four hours at 20 pounds pressure; at pH 2.0 only about 20 per cent of the activity was destroyed by similar treatment.

The vitamin G content of yeast extract was slightly decreased by passing a stream of oxygen through the extract for four hours

at 85-90 degrees C. There was no effect from passing H_2S through a similar extract for the same time and at the same temperature.

Rigorous deamination occasionally affected the vitamin G content of yeast extracts; the destruction did not seem to be due to deamination but rather to side reactions. In one case a mild acid hydrolysis followed by deamination, in which the amino-nitrogen was reduced to 2.5 per cent of the original amino-nitrogen in the extract, did not decrease the vitamin G content of a yeast extract.

Irradiation with a Cooper-Hewitt mercury arc decreased the vitamin G content of yeast and yeast extracts; the destruction was greater in alkaline than in acid solution, the result apparently being the combined effect of the separate action of alkali and irradiation.

Liver Extract as a Source of Vitamins B and G. (W. D. Salmon and N. B. Guerrant).—A daily dosage of 0.05 gm. per rat of liver extract (Lilly's No. 343) as a sole source of vitamins B and G resulted in rapid decline in weight and in the development of beriberi; 0.10 gm. per rat daily as the sole source of vitamins B and G produced a slight initial gain which was followed by a decline and eventual development of beriberi; 0.20 gm. per rat daily resulted in slow but continuous gains and prevented the onset of beriberi. The further addition of our standard vitamin B solid resulted in marked acceleration of the growth rate. The rats receiving 0.10 gm. of liver extract and 0.05 gm. of vitamin B solid per day made normal gains and appeared normal in every way. When the vitamin B supplement was added, no better results were obtained on 0.20 gm. than on 0.10 gm.

A comparison of the liver extract with dried brewer's yeast indicated that the extract contained four or five times as much vitamin G but less than one-fifth as much vitamin B as the brewer's yeast.

The Relation of High-Fat Diets to the Requirement for Vitamins B and G. (W. D. Salmon and N. B. Guerrant).—Evans and associates have concluded that fat in the diet decreases the need for vitamin B. If their conclusions are correct, there is a possible suggestion of the physiologic function of vitamin B.

The problem was studied by a slightly different technique from that used in Evans' laboratory. In our experiment, the autoclaved yeast and other vitamin preparations were fed separately instead of being mixed with basal diets. Our method permits a more accurate control of the vitamin intake.

A cornstarch-casein-salt diet which carried 30 per cent of added fat (Silverleaf lard) was found to be unsatisfactory. The rats on this diet showed signs of severe digestive disturbances in all cases where some source of vitamin G was not added to the diet. The addition of vitamin B alone did not improve the diet;

indeed, there were indications that the results were poorer when vitamin B was added unless a source of vitamin G was added at the same time. When autoclaved yeast was added to the 30 per cent fat diet without a source of vitamin B, the average length of life was 47 days on 0.15 gm. of autoclaved yeast per rat daily and 56 days on 0.50 gm. of autoclaved yeast per rat daily. This compared with an average of 30-35 days with similar amounts of autoclaved yeast and a basal diet containing only 7 per cent of added fat. This indicates some effect of fat in decreasing the requirements of the rat for vitamin B. We do not consider this result alone particularly significant, since such rats eventually died of beriberi. On a diet that contained 59.2 per cent of added fat, however, rats which received 0.15 gm. of autoclaved yeast per rat daily were in good condition when the experiment was discontinued after 126 days.

The results to date seem to indicate that only when the major portion of the energy content of the diet comes from fat, is there really a significant diminution of the vitamin B requirement. This may indicate that vitamin B functions in the relatively early stages of the converson of carbohydrate into forms which are metabolizable. The requirement of the rat for vitamin G is not decreased by increasing the fat content of the diet.

Study of Skin Flora of Rats. (W. D. Salmon and S. J. Schilling).—A study of the skin flora of the white rat may indicate how important the finding of certain types of organisms in skin lesions can be considered. Seventy-two cultures were attempted from closely clipped areas of skin on rats in the stock room and the experimental room in the laboratory. Fifty-nine of these cultures were sterile and only two of the others showed more than one to five colonies after 48 hours incubation. In no case did a normal skin yield a culture of a pigmented, gram-positive coccus. This can be considered only as a preliminary test; if it is confirmed by later studies, it may throw further light on the possible relation of infection to the skin lesions encountered in deficiency conditions.

Further Studies on the Possible Etiology of the Hemorrhagic Eschar Type of Skin Lesion. (W. D. Salmon and S. J. Schilling). —Further studies on the etiology of the eschar type of skin lesions so frequently encountered in our laboratory, have shown that a minute white mite occasionally found on some of our rats did not have a causal relationship to the lesions. The finding confirms our previous conclusion that an external parasite is not an etiologic factor for the skin lesions.

Effect of Force Molting Laying Hens. (D. F. King).—One hundred single-comb, white leghorn hens were forced into a molt during the first 14 days of July by with-holding the mash for that period, and then allowing them to eat freely of it.

As a result of this treatment, the average number of eggs

laid per hen during the year was 129. Fifty controls produced 165 eggs per hen during the year. The pens that were forced into a molt made an average profit of $2.25 per hen above feed cost in comparison with $3.00 per hen in the control pens. The fertility and hatchability of the eggs and the mortality of the hens were not affected.

BOTANY AND PLANT PATHOLOGY

The Chlorophyll-Decomposing Enzyme in the Rinds of Satsuma Oranges. (W. A. Gardner).—Repeated attempts to precipitate the enzyme, previously reported, by means of alcohol, ether, and acetone and to adsorb it by means of kaolin have been unsuccessful. On the other hand, the enzyme has been shown to be readily absorbed by 2 grams of alumina cream or of dialyzed iron to 100 cc. of orange-rind juice. The enzyme is water-soluble rather than oil-soluble. Aqueous extracts of green orange rinds are less acid than those of yellow oranges. Aqueous extracts of both green and yellow orange rinds tend to become more acid during storage.

Resistance of Sweet Potatoes to Black Rot. (W. A. Gardner).—The work of the past year is different from that reported in the literature in one respect; namely, instead of determining the percentage of resistance and susceptibility to black rot and then discarding both susceptible and "resistant" plants, the latter have been retained and further tested to determine the nature of their apparent resistance. Much progress with many varieties of sweet potatoes in greenhouse and field tests has been made towards the separation of strains resistant to black rot from susceptible strains. Certain varieties have been found wholly susceptible each time they were tested. Other varieties have yielded some escapes which show a definite degree of resistance. There are indications that some of the escapes are such because of low vigor of the inoculum; others, because they have a certain degree of resistance to disease; and still others, because they are almost, if not quite, immune to black rot.

A Disease of Winter Peas and Vetches Caused by Ascochyta sp. (J. L. Seal).—Two different species of Ascochyta, A. pisi and A. pinnodella, are generally found in pea and vetch fields in this locality and are often limiting factors in growing these crops as winter cover crops. A. pisi is confined chiefly to the above-ground parts of the plant, while A. pinnodella is confined to the lower stem and under-ground parts of the plant. These organisms readily attack the various species and varieties of Pisum, Lathyrus, Vicia and Vigna. In fields where these crops are grown year after year, these organisms assume an increasing importance.

That these organisms live from season to season on various hosts and host remains in or on our soils is clearly established.

Seeds of vetches and peas grown locally are frequently heavily infested with these organisms, while seeds grown in the semiarid West are at most only slightly infected. In this locality all fields of these crops show these diseases in varying amounts regardless of seed source.

Since the life histories of these organisms have been rather extensively studied elsewhere, emphasis is being placed on studies of seed source, seed disinfectants, and inter-relation between various crops and the prevalence of these diseases.

The Mycosphaerella Disease of Winter Peas and Vetches. (J. L. Seal).—This disease is apparently the most common and destructive disease of winter peas and vetches in this locality. The organism attacks a wide range of hosts, such as Vicia, Pisum, Lathyrus, Cicer, Vigna, Lupinus, Medicago, Trifolium, Melilotus, and Lespedeza. Under the present cropping systems, this organism goes from crop to crop on growing plants and apparently the only reason it does not appear in epidemic form each year is because of adverse climatic conditions. This organism produces an asexual stage on living plants and a sexual stage on dead plants or portions of the plant. Under local conditions either or both spore forms are involved in carrying the organism over summer on old plant parts. The organism is seed borne, and locally-produced seed frequently show a high percentage of infection. The use of pea and vetch seed grown in the semiarid West, seed treatment, and rotation of crops seem to offer the most productive studies on the control of this organism.

A New Disease of Hairy Vetch, Cause Unknown. (J. L. Seal).—During the late winter and early spring of 1929 a number of hairy vetch plantings showed an abundance of plants which were stunted, yellow to reddish in color, and failed to make normal growth. Examination of these plants showed the rootlets more or less normal, under-ground stems with red streaks, cortical area browned and enlarged, above-ground stems reddish, and the leaves yellow to reddish. Several bacteria were isolated which have not proven to be pathogenic and, in a few cases, Ascochyta pinnodella, which did not produce typical symptoms of the disease. During the past season this disease was rather rare and inconspicuous. The cause of the disease has not been determined.

ENTOMOLOGY

Boll Weevil Control With Calcium Arsenate. (J. M. Robinson and F. S. Arant).—The work on boll weevil control was continued in 1929 on Norfolk sandy loam and Houston clay. The Norfolk sandy loam plots were on the Experiment Station farm, and the Houston clay plots were in Montgomery county.

Dusting on the Norfolk sandy loam plots gave quite different results from the tests of previous years. The cotton was re-

planted so that it was two weeks later than that on the surrounding plots; consequently, the infestation on these plots did not reach 10 per cent until August 10. Three applications of calcium arsenate, beginning August 12, kept the infestation below 20 per cent until September 3. The infestation on the undusted plots had advanced to 95 per cent during the same period. The increased yield from poisoning was 46 pounds of seed cotton per acre on the unfertilized plot. The increased yield on the plot treated with 500 pounds of fertilizer was 46 pounds of seed cotton per acre; and with 1000, 1500, and 2000 pounds of fertilizer, the increases from poisoning were 134, 152, and 170 pounds of seed cotton per acre, respectively.

The six-year average increase in yield from dusting was dependent upon the time of planting, rate of fertilizer, and the percentage of infestation. Without fertilizer, dusting increased the yield 42 pounds of seed cotton per acre. With 500 pounds of fertilizer, the increase was 184 pounds of seed cotton per acre; with 1000, 1500 and 2000 pounds of fertilizer, the increases from poisoning were 328, 326, and 307 pounds of seed cotton per acre, respectively. These results show that dusting is profitable if the potential yield is one-half bale or more per acre and if the infestation exceeds 10 per cent.

The infestation on the Houston clay plots was 38 per cent June 18. Three applications of dust at four- to eleven-day intervals reduced the infestation to 2 per cent and kept it below 20 per cent until July 15. A second series of five applications kept the infestation varying from 6 to 36 per cent until August 6; the infestation on the undusted plots had advanced to 83 per cent during the same period. Two of the five applications of dust (second series) were washed off by rain within twenty-four hours. A ninth application of dust was made August 10 to protect the young bolls. The increase in yield was 223 pounds of seed cotton per acre. The average increase for the six-year period was 252 pounds of seed cotton per acre.

The Control of Citrus Insects with Oil Emulsions. (L. L. English).—*Injury to Satsumas:* Unrefined oils are more likely to cause injury than refined oils, when applied in the late fall to trees which are subsequently subjected to severe freezes. This substantiated previous results.

When the trees had been defoliated by severe winter freezes and there was a short growth of new foliage on the entire tree, severe defoliation followed the use of oil-Bordeaux combinations or Bordeaux alone. Trees quickly recovered from this type of injury. Under these conditions the white oil-Bordeaux combination was followed by more severe defoliation than a straw oil-Bordeaux combination.

Oil followed by lime-sulphur after an interval of six weeks resulted in injury. It seems that as long as oil remains on the

foliage, some "burn" is likely to take place if lime sulphur is applied.

Purple Scale Control: In an extremely heavily infested orchard, three applications of oil were necessary for satisfactory control.

Red Spider Control: An oil-Bordeaux combination was ineffective; oil alone gave results comparable to lime-sulphur.

Amount of Oil Retained by Citrus Foliage: A method has been devised for the determination of the amount of oil retained by citrus foliage. This work has led to the following conclusions:

In general, the amount of oil retained increases with viscosity; the increase is not proportional to viscosity, however, as the increase becomes less when the viscosity approaches 80 seconds (Saybolt at 100°F). Heavy oil residues may remain on the foliage three months or longer. Rainfall which occurred after the sprays had dried apparently had no effect on the oil residue. The stability of the emulsion played an important part in the amount of oil retained by the foliage. The amount was practically proportional to the concentration of the emulsion. There apparently is no difference between the residue resulting from the application of straw and white oils having the same physical properties.

Retardation of Ripening of Fruit: Oil emulsions inhibit normal coloring of satsuma fruit. In general, the higher the viscosity and the higher the concentration of the oil in the spray, the more likely there is to be retardation.

The Life History of the Pecan Weevil (*Balanius caryae*). (H. S. Swingle).—This insect has proved to be potentially the most injurious pecan insect in the central portion of this state. In one large pecan orchard, it alone has been responsible for the loss of over 50 per cent of the crop for the last several years.

Injury is caused by the weevils feeding and laying eggs within the nuts. Throughout August the adults emerged and could be found puncturing and feeding on the immature nuts. These nuts dropped from the trees within approximately a week after having been punctured. No eggs were layed until the kernels became firm. An average of 22.4 eggs per female were layed. About three eggs were usually placed in each nut, although as high as twelve have been found in a nut in the field.

The eggs hatched in from 7 to 9 days, the average time spent in this stage being 7.7 days. The larval period within the nuts varied from 15 to 117 days, the majority of the larvae emerging after about 25 days.

Upon emerging, the larvae entered the soil to a depth of from three to six inches, where they formed a larval cell and remained in the larval stage for about a year. Some of the larvae transformed to pupae and to adults the following September.

HORTICULTURE AND FORESTRY

Variety and Date of Seeding Tests with Vegetables. (C. L. Isbell).—Previous to the fiscal year 1929-30, experiments were started to determine the influence of variety and time of seeding on yield of some of the most common vegetables grown in the South.

Records considered to be of most importance obtained to June 30, 1929, appeared in the 40th Annual Report. Those obtained to June 30, 1930, occur in this report in summarized form.

Beans.—Successive planting throughout the season of 1929 of five varieties of bush snap beans, pole snap beans, and bush lima beans were compared. Results show that the yields were much greater from the first plantings with all types of beans. Dry weather and damage from bean beetle partly account for low yields with later plantings. The most outstanding differences in yields occurred in the varieties of bush lima. Yields of Burpees New Improved and Fordhook were very low compared with other varieties.

Cantaloupes.—A planting consisting of five varieties was made April 4, 1929. Results show that Hales Best matured earliest, produced the greatest number of melons per hill and the greatest total yield. The quality of this melon is good.

Corn for roasting ears.—Plantings were made March 22, April 12, April 22, and June 14, 1929, of five of the most commonly grown varieties of field corn for roasting ear purposes and of the Stowell's Evergreen variety of sweet corn. The first planting was damaged considerably by moles which influenced the relative yields of the different varieties. Results show that Early White Dent, Snow Flake, and Truckers Favorite are earliest and tend to be low yielding. Silvermine and Mexican June are latest and tend to be the heaviest yielders.

Kale.—Plantings were made in September and October 1929. Results show that Tall Green Curled Scotch and Siberian are heaviest yielders and that the Siberian variety should be planted where the winter is likely to be severe. The heavy freezes during December checked the growth and caused some foliage injury of the Siberian variety, but plants were not killed. This variety grew well in late winter and early spring.

Lettuce.—Plantings of twenty-five varieties were made September 20 and October 22, 1929. The second planting was damaged by "damping off", and both plantings were badly damaged by the December freezes.

The following varieties were noticeably hardy to winter temperatures: Danvers (Drumhead or Malta), Hubbard Market (St. Louis Market), and Unrivaled (Improved Big Boston).

A planting consisting of eight varieties was made February

22, 1930. The weather was very dry during the period when plants were maturing. Paris White Cos, Improved Hanson, Grand Rapids, New York, and Big Boston produced the highest yields.

English Peas.—A few varieties of the dwarf type and of the running type of peas were planted February 20, 1930. The period of harvest and the yields are shown in Table 7.

Table 7.—Period of Harvest and Yields of Different Varieties of English Peas in Pounds per Acre.

Variety	Period of Harvest	Yield
Alaska*	5- 3 to 5- 9	9,771
Ameer*	5- 3 to 5- 9	8,767
Little Moral*	5- 3 to 5- 9	8,699
Dwarf Telephone*	5- 5 to 5-21	7,183
Bliss Everbearing	5- 5 to 5-21	6,709
Champion of England	5- 5 to 5-21	3,331
Improved Stratagem	5- 5 to 5-21	4,807
Prosperity	5- 3 to 5- 9	10,857
Telephone	5-12 to 5-27	7,532
Thomas Laxton	5- 3 to 5- 9	10,623

*Dwarf types.

Irish Potatoes.—Six varieties were tested in the spring of 1929 and 1930. Table 8 gives the average of results obtained for the two years.

Table 8.—Average Yield of Different Varieties of Irish Potatoes in Pounds Per Acre for 1929-30.

Variety	Grade			Total
	No. 1	No. 2	Culls	
Cobbler	4,425	1,158	410	5,993
Green Mountain	6,538	642	309	7,489
Lookout Mountain	2,334	1,002	319	3,655
Rosefour	5,380	2,306	605	8,291
Triumph	4,737	1,535	567	6,839
White Star	5,210	1,505	512	7,227

Fertilizer Experiments with Pecans in Dallas County. (R. W. Taylor).—An experiment was started in 1926 with 16-year-old Stuart pecan trees on Norfolk fine sandy loam soil to compare the response from an annual application in May or June of 35 pounds per tree of a 4-10-4 fertilizer with that from a 0-10-4 or from a double amount of the complete fertilizer. Nitrogen was derived from nitrate of soda, phosphorus from basic slag and potassium from muriate of potash. Plots consisted of 7 very uniform trees each. No cover crops were grown, and the growth of weeds was checked by an occasional disking of the soil.

The average annual yield per tree for the three-year period, 1927-1929, inclusive, where only phosphate and potash were

applied was 8.2 pounds. Where nitrate of soda was added to the phosphate and potash, the yield was 10.5 pounds, and where a double amount of complete fertilizer was applied, the yield was 13.3 pounds.

In 1929 both plots receiving complete fertilizer matured an average of 18 pounds of nuts per tree. The nuts from the heavier fertilized trees were smaller, 75 ± 2.29 being required to weigh a pound as compared with 66 ± .87 nuts to the pound from trees receiving the smaller amount of complete fertilizer. The fact that the heavily fertilized trees had a greater shoot growth and that a drought prevailed at a critical period may have accounted for the small size of the nuts.

Fertilizer Experiments with Irish Potatoes in Baldwin and Escambia Counties. (R. W. Taylor).—Complete fertilizers carrying different amounts of each nutrient per acre were compared. Sulfate of ammonia as the source of nitrogen was compared with combinations of sulfate of ammonia and nitrate of soda.

When used with 1200 pounds of superphosphate and 250 pounds of muriate of potash per acre, 400 pounds of nitrate of soda gave more economical yields than 600 pounds on Norfolk sandy loams as shown by the average of four plots. The yield per acre was 173 bushels where 400 pounds of nitrate of soda were used as compared with 176 bushels when 600 pounds were used, but the yields of U. S. No. 1 tubers were 142 and 137 bushels, respectively. The yields were still lower when 800 and 1000 pounds of nitrate of soda were used, due to vine growth being continued late in the season at the expense of tuber production.

When used with 800 pounds of nitrate of soda and 250 pounds of muriate of potash per acre, 1200 pounds of superphosphate gave a higher yield than 800 pounds. The per acre average yield when 800 pounds of superphosphate were used was 156 bushels with 122 bushels of U. S. No. 1 grade as compared with a yield of 186 bushels with 141 bushels of No. 1 tubers when 1200 pounds were applied.

When used with 1200 pounds of superphosphate and 800 pounds of nitrate of soda per acre, 200 pounds of muriate of potash gave higher yields than 100 pounds. The yield per acre with 100 pounds was 164 bushels as compared with 172 bushels where 200 pounds of muriate of potash was applied.

Sulphate of ammonia used at the rate of 486 pounds per acre as the source of nitrogen in a complete fertilizer, gave a lower yield than combinations of sulfate of ammonia with nitrate of soda. The yield when all the nitrogen was derived from sulfate of ammonia was 135 bushels per acre. When ¾ of the nitrogen was from sulfate of ammonia and ¼ from nitrate of soda, the yield was 181 bushels, but when only ¼ was from sulfate of ammonia the yield was 191 bushels per acre. Sulfate of ammonia

applied in the larger quantities was injurious, as evidenced by a red color and a dwarfed appearance of the tips of the plant.

Spacing and Seed-Piece Test with Potatoes in Baldwin County. (R. W. Taylor).—Hill-spacing tests were conducted, using 1-ounce seed pieces in 3½ foot rows. With 10, 12 and 14 inch spacing the yield of No. 1 tubers was practically the same in each case, averaging 139 bushels per acre. The total yields corresponding to the spacings in the order given were 176, 167 and 150 bushels per acre. Seed pieces weighing ½ ounce, 1 ounce and 1½ ounces were compared as to yield when spaced 14 inches in 3½ foot rows. With ½, 1 and 1½-ounce seed pieces the yields were 128, 154 and 177 bushels per acre, respectively, the corresponding yields of No. 1 grade being 95, 139 and 152 bushels per acre.

Influence of Fertilizer Treatment on the Yield and Quality of the Irish Potato. (W. D. Kimbrough).—With variations of a basic fertilizer treatment for potatoes consisting of 800 pounds of superphosphate, 400 pounds of nitrate of soda and 150 pounds of muriate of potash, yields in the spring of 1930 indicated the need of a complete fertilizer. Comparisons of the yields of marketable potatoes from plots receiving various combinations of two elements and from those receiving combinations of the three elements showed an increase of 72 per cent for nitrogen, of 70 per cent for phosphorus, and of 11 per cent for potassium. Doubling the amount of all three materials in the basic application increased the yield of marketable potatoes only 12 bushels at a cost of $18. Yields were approximately the same for muriate of potash and sulfate of potash. Sulfate of ammonia gave a small increase over nitrate of soda.

Data this year support the findings of the previous year showing no differences in shrinkage during storage, or in keeping quality, and only very slight differences in moisture, starch, and sugar content that could be attributed to fertilizer treatment.

The Quality of the Strawberry as Affected by Rainfall, Fertilizer Treatment, and Soil Moisture. (W. D. Kimbrough).—Comparisons of the quality of strawberries based on determinations of moisture content, sugar content, and firmness showed a much greater difference in the berries due to rainfall and to variations in soil moisture than to fertilizer treatment. Differences as great as 3 per cent in total sugars were found in berries harvested at different periods during the same season while the greatest difference in sugar content of berries harvested within any given period which could be attributed to different fertilizer treatment was 1.45 per cent. Berries from plots which were regularly watered showed a difference in total sugars of 3.32 per cent when compared to berries from unwatered plots receiving the same fertilizer treatment, while the greatest difference ever found between berries from unwatered plots receiving different fertilizer treatments was only 0.72 per cent.

SPECIAL PROBLEMS

Relative Earliness of Winter Legumes. (J. F. Duggar).—The initial blooming date of the following closely related plants averaged earlier than that of hairy vetch by 28 days for Scotch vetch, 20 for narrow-leaved vetch, 18 for bitter vetch, 17 for Monantha vetch, 10 to 13 for crimson clover, 8 for woolly-pod vetch, 5 for Tangier pea, and 4 for Oregon vetch; Austrian winter peas averaged 3 days later in blooming than hairy vetch, and purple vetch still later.

Root-Nodule Formation on Lespedeza Species. (J. F. Duggar).—Korean lespedeza was much slower than common lespedeza in developing root nodules. Common lespedeza required only 11 to 14 days from emergence for 85 per cent of its plants to become stocked with root tubercles. On the other hand, Korean lespedeza seedlings required, in repeated experiments, at least 16, 23, 25, 27 and 28 days for the same result.

Tennessee No. 76 lespedeza developed nodules about as rapidly and freely as common lespedeza; Kobe lespedeza followed the common species much more closely than it did Korean in the time required for generalized nodule formation.

Peanuts Inadequately Stocked with Root Tubercles. (J. F. Duggar).—Spanish peanuts grown from commercial seeds were found to be tardily and scantily supplied with root nodules when grown at Auburn on a field of Norfolk sandy loam soil where no peanuts had been grown in recent years. For example, on the plots not artificially inoculated only 24 per cent of the plants showed any root tubercles 49 days after coming up, and only 55 per cent of the plants had any tubercles when more than two months old.

An Important Cause of Frequent Failures of Alfalfa. (J. F. Duggar).—Repeated counts made of alfalfa samples from various fields, both in Black Belt counties and at Auburn, showed that in certain warm months 10 to 80 per cent of the stems had been girdled by the three-cornered alfalfa hopper (Stictocephala festina, Say). The usual symptoms are yellowing of foliage, stunting of growth, or death of the affected stems.

Dusting experiments on very small unseparated areas in the field resulted in a considerable reduction in the percentage of girdled plants and in the number of larvae observable at given dates thereafter.

Sodium fluosilicate seemed more effective than a nicotine preparation, sulphur, or paradichlorobenzene, though from applications made on some dates, others of these insecticides seemed also helpful. Thirty-four days after a dusting with sodium fluosilicate made on August 9, only 9 per cent of girdled stems was found as compared with 16 per cent on the immediately adjacent untreated plot.

The characteristic injuries inflicted by the three-cornered alfalfa hopper were observed in 1929 on 25 kinds of legumes; alfalfa and white biennial melilotus were the species most severely damaged.